Discussion of Seasonal Adjustment of Time Series During the Pandemic

Lester Mackey

Microsoft Research

Questions from the Bureau

- Question 1: Do you have any general thoughts about how we are dealing with pandemic effects in seasonal adjustment?

- Question 2: Do you have any ideas for determining when pandemic effects have ended, realizing that this can vary across and within economic sectors?

- Question 3: Do you have any ideas for determining whether seasonal patterns have changed (shifted) post pandemic?

Response to Question 1: Dealing with pandemic effects in seasonal adjustment

- **Overall:** A well-reasoned and practical approach!
  - Assuming that we trust the usual (X-13) seasonal adjustments in non-pandemic times, fitting the usual model to only pre-pandemic data and forecasting forward seems natural
  - Possible that seasonality has changed since March 2020 but may be difficult to disentangle those changes from the larger pandemic effects (without more data)

Response to Question 1: Dealing with pandemic effects in seasonal adjustment

- **Validation**
  a) What criteria does the Bureau use to evaluate the quality of seasonal adjustment procedures and to declare a procedure suitable?

Response to Question 1: Dealing with pandemic effects in seasonal adjustment

- **Validation**
  a) What criteria does the Bureau use to evaluate the quality of seasonal adjustment procedures and to declare a procedure suitable?
  b) Are there prior anomalous periods (e.g., the Great Depression) with agreed-upon ground-truth seasonality that can be used to judge effectiveness?

Response to Question 1: Dealing with pandemic effects in seasonal adjustment

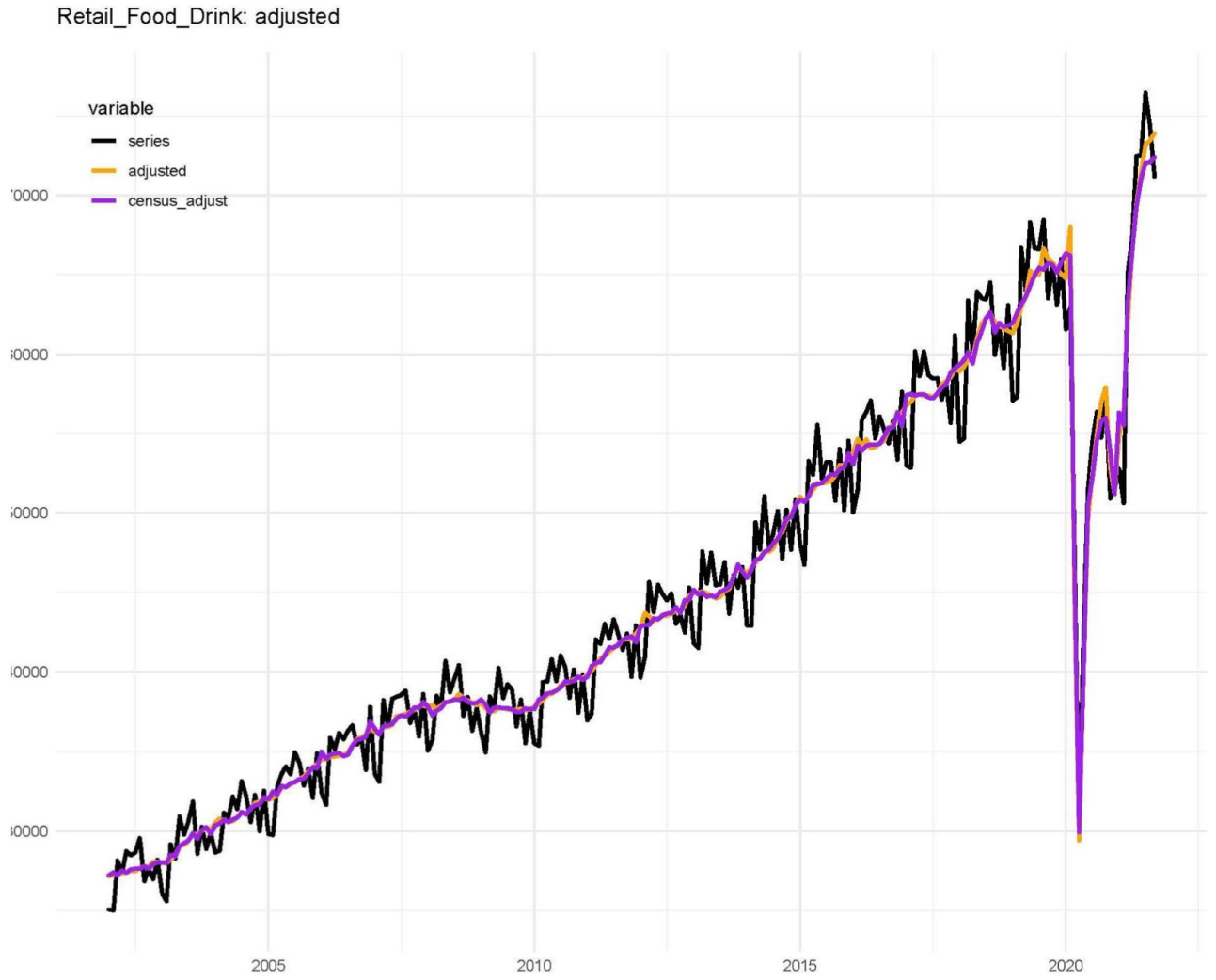
- **Validation**
  a) What criteria does the Bureau use to evaluate the quality of seasonal adjustment procedures and to declare a procedure suitable?
  b) Are there prior anomalous periods (e.g., the Great Depression) with agreed-upon ground-truth seasonality that can be used to judge effectiveness?
  c) Are there standard simulation settings with realistic anomaly patterns and known seasonality?

Response to Question 1: Dealing with pandemic effects in seasonal adjustment

- **Validation**
  a) What criteria does the Bureau use to evaluate the quality of seasonal adjustment procedures and to declare a procedure suitable?
  b) Are there prior anomalous periods (e.g., the Great Depression) with agreed-upon ground-truth seasonality that can be used to judge effectiveness?
  c) Are there standard simulation settings with realistic anomaly patterns and known seasonality?
  d) Semi-synthetic evaluation
    - Start with real time series data with no expected outliers, estimate seasonality in the usual way, and treat the estimated seasonality as ground truth
    - Introduce a synthetic outlier sequence (e.g., modeled after pandemic behavior)
    - Evaluate how well each method reconstructs the ground truth seasonality in the presence of these outliers

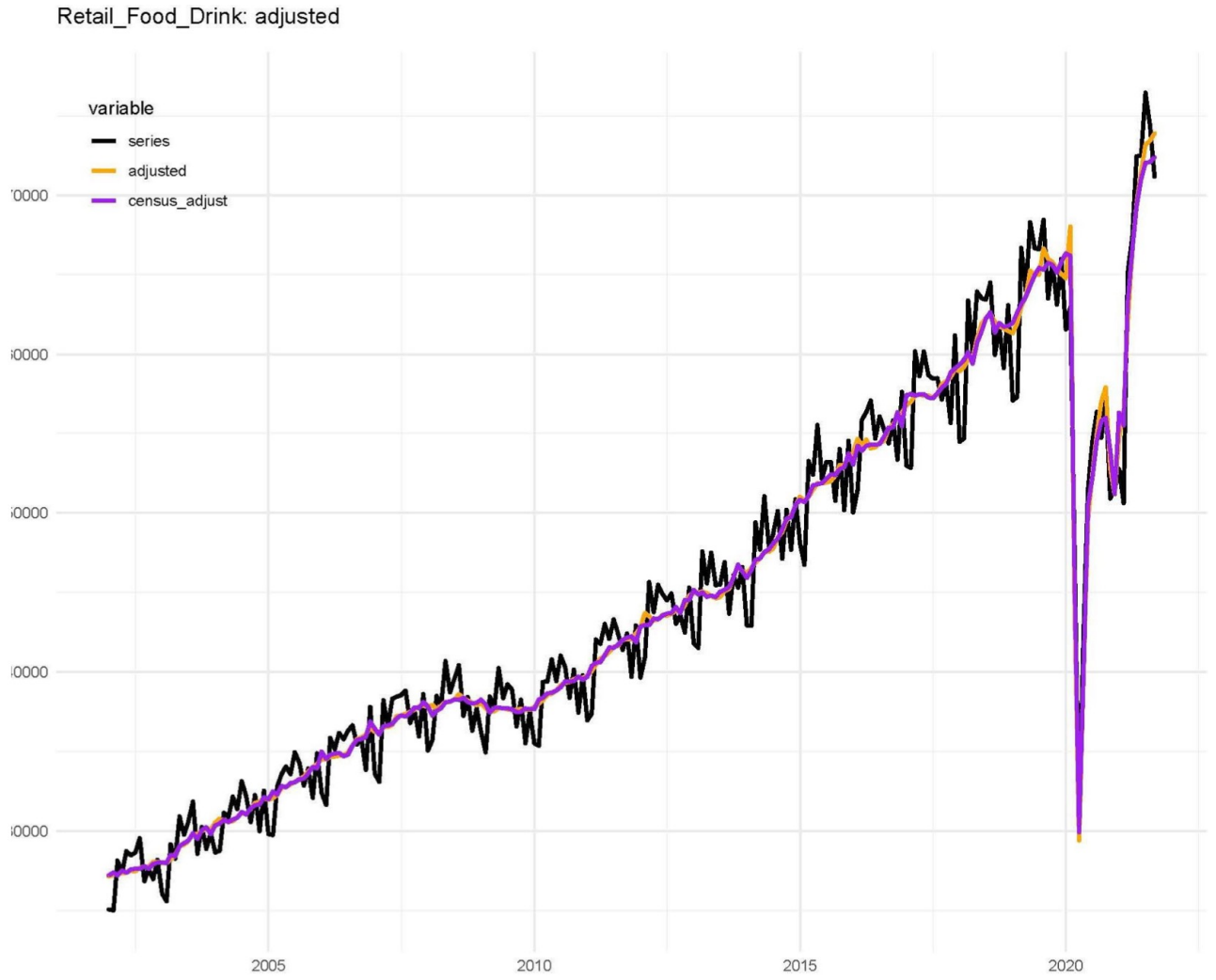
Response to Question 1: Dealing with pandemic effects in seasonal adjustment

- **Alternative procedures**
  a) Are the visible differences between the X-13ARIMA-SEATS and Bayesian adjustments significant, either statistically or practically? If so, how does the Bureau determine which is preferable?



Response to Question 1: Dealing with pandemic effects in seasonal adjustment

- **Alternative procedures**
  a) Are the visible differences between the X-13ARIMA-SEATS and Bayesian adjustments significant, either statistically or practically? If so, how does the Bureau determine which is preferable?
  b) What is the impact of modeling seasonal adjustments with X-11 versus SEATS, and how is one selected over the other?



Response to Question 2: Determining when pandemic effects have ended

- **Overall:** A well-reasoned and practical approach!
  - Using X13's built-in outlier detection to test for the presence of outliers amongst recent timepoints seems natural

Response to Question 2: Determining when pandemic effects have ended

- **Overall:** A well-reasoned and practical approach!
  - Using X13's built-in outlier detection to test for the presence of outliers amongst recent timepoints seems natural
  - Is every timepoint after February 2020 tested for having an outlier? Are early pandemic timepoints manually inputted as fixed outliers and only later timepoints tested? In the latter case, how is the range of manual input timepoints selected?

Response to Question 2: Determining when pandemic effects have ended

- **Overall:** A well-reasoned and practical approach!
  - Using X13's built-in outlier detection to test for the presence of outliers amongst recent timepoints seems natural
  - Is every timepoint after February 2020 tested for having an outlier? Are early pandemic timepoints manually inputted as fixed outliers and only later timepoints tested? In the latter case, how is the range of manual input timepoints selected?
- **Validation**
  a) What criteria does the Bureau use to evaluate and compare procedures for detecting the end of anomalous periods?
  b) Could evaluate effectiveness on prior anomalous periods (e.g., the Great Depression) with agreed-upon end-points, simulations, or semi-synthetic data

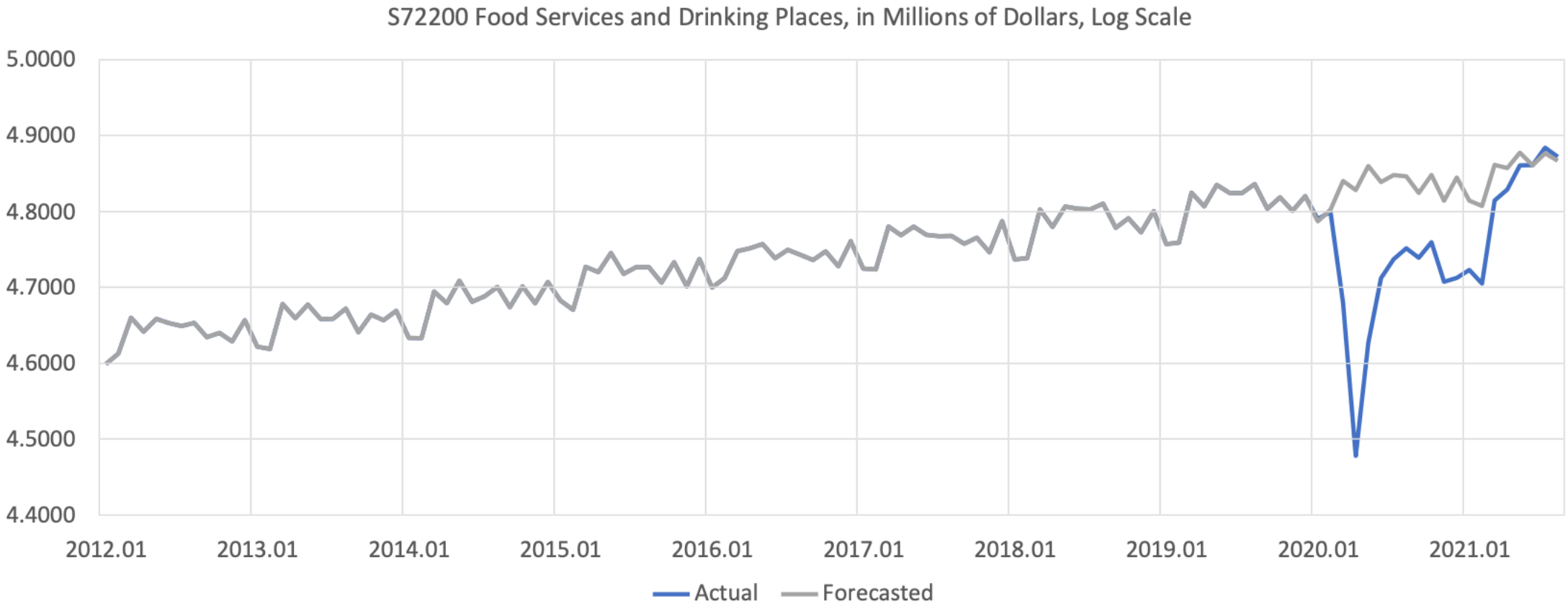
Response to Question 3: Determining if seasonal patterns have changed post-pandemic

- **Overall:** May be difficult to disentangle seasonal changes from anomalous pandemic shifts without more post-pandemic data

Response to Question 3: Determining if seasonal patterns have changed post-pandemic

- **Overall:** May be difficult to disentangle seasonal changes from anomalous pandemic shifts without more post-pandemic data
- **Speculative**
  a) Can we share strength across time series to estimate seasonal patterns and detect changes?
  b) Are there **external** indicators of a target variable's seasonality from other time series or data sources?
  c) Can we leverage sectors that are back to normal and historical seasonality relationships across sectors?
  d) Can we leverage data from other countries that were impacted by the pandemic at different times?

Quality of forecast extension



Source: [Monthly Retail Trade and Food Services, U.S. Census Bureau (census.gov/retail/)]

- How accurate is this forecast extension procedure when tested on pre-pandemic years? For example, if you withhold all data after Feb. 2019, how well do you forecast March 2019 - Feb. 2020?

Maximum entropy method

- Is the seasonality component of this model fit only to pre-pandemic data? Does it also make use of the projected blue curve values after Feb. 2020?